

A SYNOPSIS OF THE GENUS *SCIRPUS* *sens. lat.* (CYPERACEAE) IN AUSTRALIA

K. L. WILSON

(Accepted for publication 27.11.1980)

ABSTRACT

Wilson, K. L. (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, New South Wales, Australia) 1981. The genus Scirpus sens. lat. (Cyperaceae) in Australia. Teloepa 2 (2): 153-172.—All Australian species (both native and naturalized) that were formerly referred to *Scirpus sens. lat.* are placed in the segregate genera *Bolboschoecus* (3 spp.), *Hymenochacta* (1 sp.), *Isolepis* (28 spp.), *Schoenoplectus* (11 spp.), *Scirpus sens. strict.* (1 sp.), or are referred to other genera (*Cyperus sens. lat.*, *C. haunulosus*; and *Lipocarpa*, *L. microcephala*). New combinations are made for *Isolepis humillima*, *I. monivaga*, *I. oldfieldiana*, *I. producta*, *I. setiformis*, *I. stellata*, *I. tasmanica*, *I. victoriensis* and *I. wakefieldiana*. Keys are provided to genera and species.

INTRODUCTION

Scirpus has been circumscribed in a broad sense in all Australian and many other Floras, even though it has been regarded as heterogeneous by recent authors (e.g., Kern 1974). Raynal (1973) described *Scirpus* as "manifestement un genre résidu", composed of all the elements left in the subfamily Cyperoideae after the most strikingly different elements had been separated as genera. This is an apt description.

In this paper, the species of *Scirpus sens. lat.* occurring in Australia are placed in their segregate genera with appropriate comments on their status, relationships and distribution. Keys are provided to both genera and species. Reference is made to species descriptions in recent Floras (where available), while further generic synonymy and descriptions may be found in Koyama (1958, 1979). Comments are made on poorly known species or groups that need further study, as I do not pretend in this paper to solve all the taxonomic problems associated with these taxa.

Scirpus was heterogeneous even when first described, including species now assigned to *Cyperus sens. lat.*, *Eleocharis*, *Fimbristylis* and *Scleria*, as well as species now in segregate genera such as *Isolepis*. Many new segregate genera were set up in the nineteenth century and concepts became very confused. This led to extensive synonymising of genera, culminating in the revision of *Scirpus* by Koyama (1958), in which even *Eriophorum*, *Fnirena* and *Hemicarpha* were included in *Scirpus*. Recent workers, including Koyama himself (1979), have rejected Koyama's inclusive view of *Scirpus* as leading to a large unwieldy genus that includes various groups not closely related to each other.

Evidence from embryological and physiological studies has given fresh impetus to taxonomic study of the subfamily Cyperoideae, to which *Scirpus* and most of its segregates belong. In his study of embryo-types in Cyperoideae, Van der Veken (1965) classified the mature embryos into six types (with some variants), all of which he found represented in *Scirpus sens. lat.* He distinguished these types on the basis of the shape of the mature embryo, the position of the coleoptile and radicle at maturity, and the orientation of the germination pore of the coleoptile ("le pore ou la fente germinative du coléoptile"). The embryos of Australian *Scirpus* segregates fall into three of his types (see Table 1), and the detailed listing of genera that follows in this paper groups them accordingly. Van der Veken did not make any formal nomenclatural changes but he gave his opinion on the appropriate taxonomic

1. SCIRPUS *L. sens. str.*, Sp. Pl. 1: 47 (1753); Gen. Pl., edn 5: 26 (1754); Koyama, J. Fae. Sci. Univ. Tokyo, Sect. 3, Bot., 7: 282, 292 (1958); Oteng-Yeboah, Notes Roy. Bot. Gard. Edinburgh 33: 311 (1974).

Type species: *S. sylvaticus* L.

About 20 species; mainly boreal, especially well developed in North America and Asia.

There has been disagreement about the typification of this genus but *S. sylvaticus*, the choice of Hitchcock & Green (1929), is now generally accepted as the lectotype. Most American botanists have taken *S. lacustris* L. as lectotype but that is now accepted as the type of *Schoenoplectus* (q.v.).

1. S. polystachyus *F. Muell.*, Trans. Philos. Soc. Victoria 1: 108 (1855).—*Lectotype* (here designated): Lake Omeo, *Mueller* 1.1854 (MEL).

Description: Burbidge & Gray (1970: 80).

Distribution: Tableland regions of southern Qld., N.S.W. and Vic. This species belongs to Section *Lineatus* of Oteng-Yeboah (1974 b), characterised by the tufted habit and long, filiform hypogynous bristles.

2. HYMENOCHAETA *Beauv. ex Lestib.*, Essai Fam. Cypéacées: 43 (1819); Nees, Edinburgh New Philos. J. 17 (34): 264 (1834), as "*Hymenochaete*."—*Scirpus* sect. *Actinoscirpus* Ohwi, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol., 18: 98 (1944); Koyama, J. Fae. Sci. Univ. Tokyo, Sect. 3, Bot., 7: 289 (1958).

A monotypic genus, extending from India to southern China and tropical Australia (Qld., N.T.). It is closely related to *Schoenoplectus* (q.v.).

1. H. grossa (*L. f.*) *Nees*, Edinburgh New Philos. J. 17 (34): 264 (1834).—*Scirpus grossus* *L.f.*, Suppl. Sp. Pl.: 104 (1781).—*Schoenoplectus grossus* (*L.f.*) *Palla*, Allg. Bot. Zeitschr. 17: Beibl. 3 (1911); Koyama in Hara et al., Enum. Fl. Pl. Nepal 1: 118 (1978).

Description: Kern (1974: 498).

Distribution: See above.

3. BOLBOSCHOENUS (*Aschers.*) *Palla* in Hallier, Synops. Deutsch. Schweiz. Fl. 3: 2531 (1905); Koyama in Hui-Lin Li et al., Fl. Taiwan 5: 206 (1979).—*Scirpus* section *Bolboschoenus* *Aschers.*, Fl. Brand. 1: 753 (1864); Koyama, J. Fae. Sci. Univ. Tokyo, Sect. 3, Bot., 7: 288 (1958).

Type species: *B. maritimus* (*L.*) *Palla* (*Scirpus maritimus* *L.*).

About 16 species widely distributed on all continents. This genus is close to *Schoenoplectus* (q.v.) and could be included in it if one took a broad view of generic limits (Lye 1971 b & c), in which case *Hymenochaeta* should also be included. "*Malacogeton*" appears to be intermediate between *Bolboschoenus* and *Schoenoplectus*, being placed under the former by Koyama (1958) and under the latter by Oteng-Yeboah (1974 b). Its embryo-type conforms better with that of *Schoenoplectus* than that of *Bolboschoenus* (Van der Veken 1965), which supports Oteng-Yeboah's placement of it as *Schoenoplectus* subgenus *Malacogeton*, based upon its culm anatomy and inflorescence and nut characters.

Bolboschoenus has the most advanced embryo in the subfamily Cyperoideae, a highly differentiated form of the *Schoenoplectus* embryo-type. Leaf anatomy also suggests that the genus is derived from *Schoenoplectus* (Schuyler 1971 b). Morphologically, *Bolboschoenus* is distinctive with its noded culms and leafy involueral bracts; in the context of related genera it seems best to treat it as a genus. Specific limits are not clear and a worldwide study is needed.

Key to *Bolboschoenus* species in Australia

1. Nut trigonous, equilateral, with the dorsal angle acute; style 3-fid 2. *B. fluviatilis*
- 1.* Nut lenticular or trigonous with the dorsal angle obtuse; style 2-3-fid.
 2. Style 2-fid; nut lenticular with concave sides, straw-coloured to deep golden-brown, the surface \pm shining, minutely reticulate 1. *B. caldwelii*
 - 2.* Style 2-3-fid; nut plano-convex or trigonous with convex sides, red-brown to black, the surface shining, not obviously reticulate 3. *B. medianus*

1. *B. caldwelii* (*V. J. Cook*) *Soják*, Čas. Nár. Mus., Odd. Přír. 141: 62 (1972).—*Scirpus caldwelii* *V. J. Cook*, Trans. & Proc. Roy. Soc. New Zealand 76: 568, pl. 56, fig. 3 (1947).

Description: Moore & Edgar (1970: 174).

Distribution: N.S.W., Vic., Tas., S.A., SW. W.A.; New Zealand.

2. *B. fluviatilis* (*Torrey*) *Soják*, Čas. Nár. Mus., Odd. Přír. 141: 62 (1972).—*Scirpus maritimus* *L. var. fluviatilis* *Torrey*, Ann. Lyceum Nat. Hist. New York 3: 324 (1826).—*Scirpus fluviatilis* (*Torrey*) *A. Gray*, Manual Bot. N. United States: 527 (1848).

Description: Moore & Edgar (1970: 173).

Distribution: SE. Qld. and coastal N.S.W.; New Zealand, Asia, North America.

3. *B. medianus* (*V. J. Cook*) *Soják*, Čas. Nár. Mus., Odd. Přír. 141: 63 (1972).—*Scirpus medianus* *V. J. Cook*, Trans. & Proc. Roy. Soc. New Zealand 76: 569, pl. 56, fig. 2 (1947).

Description: Moore & Edgar (1970: 174).

Distribution: N.S.W., Vic., Tas., S.A.; New Zealand, ? New Guinea.

4. **SCHOENOPLECTUS** *Palla*, Verh. K.K. Zool.-Bot. Ges. Wien 38, Sitzb.: 49 (1888); Bot. Jahrb. Syst. 10: 298 (1889); Koyama in Hui-Lin Li et al., Fl. Taiwan 5: 207 (1979); *nom. cous.*—*Scirpus* section *Actaeogeton* *Reichb.*, Fl. German. Exeurs.: 78 (1830); Koyama, J. Fac. Sei. Univ. Tokyo, Sect. 3, Bot., 7: 284 (1958).

Type species: *S. lacustris* (*L.*) *Palla* (*Scirpus lacustris* *L.*).

About 60 species, widely distributed on all continents. This is one of the largest *Scirpus* segregates and has been variously defined in the past to include, amongst others, *Bolboschoenus* and *Isolepis* (see Lye (1971 b) and Raynal (1976 a) for details of the nomenclatural history of the genus). The *Schoenoplectus* embryo-type ('*Scirpus*' of Van der Veken) is considered to be the most advanced in the Cyperoideae, having evolved from a *Cyperus*-type embryo (which *Isolepis* possesses (Van der Veken 1965), indicating at least a distant relationship between *Isolepis* and *Schoenoplectus*). The relationship between *Schoenoplectus*, *Bolboschoenus* (*q.v.*) and *Hymenochaeta* (*q.v.*) is much closer. They share the same basic embryo-type but in varying stages of differentiation: *Hymenochaeta* has the least and *Bolboschoenus* the most differentiated. The gross morphology of these three taxa differs, as will be seen from the generic key, and, since this is correlated with the embryo variation, there seems sufficient reason to retain them as separate genera.

2. *Sch. dissanchanthus* (*S. T. Blake*) *J. Raynal*, *Adansonia* 16: 139 (1976).—*Scirpus dissachanthus* *S. T. Blake*, *Victorian Naturalist* 63: 116 (1946).

Description: Black (1978: 298).

Distribution: Inland regions of all mainland Australian States.

3. *Sch. erectus* (*Poir.*) *Palla ex J. Raynal*, *Adansonia* 16: 141 (1976).—*Scirpus erectus* *Poir.*, *Encycl. Méth., Bot.* 6: 761 (1805).

Scirpus raynolii Schuyler, *Notul. Nat. Acad. Nat. Sci.* 438: 1 (1971).

Distribution: Scattered occurrences in *Qld., † *N.S.W., *Vic.; Africa, Asia, North and South America.

This species has been confused with *S. lateriflorus* (c.g. Blake 1952) but they are distinct, as pointed out by Kern (1974). *S. erectus* has larger glumes, bifid style, larger biconvex nuts and a longer appendage on the anther connective.

4. *Sch. laevis* (*S. T. Blake*) *J. Raynal*, *Adansonia* 16: 151 (1976).—*Scirpus laevis* *S. T. Blake*, *Proc. Roy. Soc. Queensland* 51: 177 (1940).

Distribution: Inland regions of Qld., N.S.W., W.A. and N.T.

5. *Sch. lateriflorus* (*Gmel.*) *Lye*, *Bot. Not.* 124: 290 (1971).—*Scirpus lateriflorus* *Gmel.*, *Syst. Veg.*, edn 13, 1: 127 (1791).—*Sch. supinus* (*L.*) *Palla ssp. lateriflorus* (*Gmel.*) *T. Koyama in Hara et al.*, *Enum. Fl. Pl. Nepal* 1: 119 (1978).

Description: Kern (1974: 514).

Distribution: Tropical Qld., N.T. and W.A.; South-east Asia.

S. erectus (*q.v.*) and this species have often been confused.

6. *Sch. lineolatus* (*Franch. & Sav.*) *T. Koyama in Hui-Lin Li et al.*, *Fl. Taiwan* 5: 215, Pl. 1322 (1979).—*Scirpus lineolatus* *Franch. & Sav.*, *Enum. Pl. Japon.* 2: 112 (1877), 544 (1879).

Scirpus forsythii *Kükenth.*, *Repert. Spec. Nov. Regni Veg.* 12: 94 (1913), *synon. nov.*—Holotype: Nepean River, *W. Forsyth* (B—not seen). Isotypes: MEL, NSW, P.

Description: Koyama (1979: 215).

Distribution: *N.S.W., *Vic.; Japan, Taiwan.

Schoenoplectus lineolatus is only known in Australia from three old and poorly documented specimens collected near Sydney and two very immature specimens from the Genoa River in the far north-east of Victoria. The stolons on these five specimens are not well-developed but otherwise there is agreement with the descriptions and specimens of *S. lineolatus* that I have seen from Japan. The sporadic occurrence in Australia suggests an introduced species.

7. *Sch. litoralis* (*Schrad.*) *Palla*, *Bot. Jahrb. Syst.* 10: 299 (1889).—*Scirpus litoralis* *Schrad.*, *Fl. Germ.* 1: 142, t. 5, fig. 7 (1806).

Schoenoplectus subulatus (*Vahl*) *Lye*, *Bot. Not.* 124: 290 (1971).

Description: Kern (1974: 510).

Distribution: Qld., N.S.W., N.T., S.A., W.A.; Mediterranean region to Africa and Asia. Very scattered in Australia and possibly introduced.

† An asterisk before the name of a State or region implies that the species is introduced to that area.

Specimens from Africa, India, Malesia, Micronesia and Australia have sometimes been distinguished as *S. subulatus* or *S. litoralis* ssp. *thermalis* (Trab.) Murb. in contrast to typical *S. litoralis*, which occurs in the Mediterranean region, S.W. Asia and China. Koyama (1958), Townsend (1962) and Kern (1974) agree that the only reliable distinguishing character between these two taxa is the culm shape: triquetrous in typical *S. litoralis* and terete (but trigonous just below the inflorescence) in *S. subulatus*. They disagree on whether this distinction is sufficient to warrant specific or even subspecific rank, and I have not yet seen sufficient material from regions other than Australia to form an opinion.

8. *Sch. mucronatus* (L.) Palla ex Kerner, Sched. Fl. Austr.-Hung. 5: 91 (1888).—*Scirpus mucronatus* L., Sp. Pl., 1: 50 (1753).

Description: Kern (1974: 510).

Distribution: Qld., N.S.W., N.T., W.A.; Europe, Asia, Malesia, New Hebrides.

9. *Sch. praelongatus* (Poir.) J. Raynal, Adansonia 16: 148 (1976).—*Scirpus praelongatus* Poir., Encycl. Méth., Bot. 6: 764 (1805).

Description: Kern (1974: 513).

Distribution: Tropical Qld., N.T., W.A.; India to Vietnam, Malesia.

This species has often been considered a form of *S. articulatus* (q.v.).

10. *Sch. pungens* (Vahl) Palla, Bot. Jahrb. Syst. 10: 299 (1889).—*Scirpus pungens* Vahl, Enum. Pl. 2: 255 (1805); Schuyler, Rhodora 76: 51–52 (1974).

[*Scirpus americanus* auct. non Pers.]

Description: Black (1978: 296).

Distribution: N.S.W., Vic. Tas., S.A.; Europe, North and South America, New Zealand.

S. pungens has been widely known as *S. americanus*; the true *S. americanus* (Pers.) Volkart (*Scirpus olueyi* A. Gray) is found in North and Central America.

11. *Sch. validus* (Vahl) A. Löve & D. Löve, Bull. Torrey Bot. Club 81: 33 (1954).—*Scirpus validus* Vahl, Enum. Pl. 2: 268 (1805); Blake, Trans. & Proc. Roy. Soc. South Australia 67: 54 (1943).—*Scirpus lacustris* L. ssp. *validus* (Vahl) Koyama, Canad. J. Bot. 40: 927 (1962).

Description: Black (1978: 299).

Distribution: All Australian States except the Northern Territory; countries bordering the Pacific Ocean; New Caledonia, New Hebrides.

5. ISOLEPIS R. Br., Prodr.: 221 (1810); Raynal, Adansonia 17: 49 (1977).—*Scirpus* section *Isolepis* (R. Br.) Griseb., Spicil. Fl. Rumel Bith. 2: 417 (1845); Koyama, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot., 7: 284 (1958).—*Eleogiton* Link, Hort. Berol. 1: 284 (1827).—*Scirpus* section *Eleogiton* (Link) Reichb., Icon. Fl. German. 8: 38 (1846); Koyama l.c.: 283.

Type species: *I. setacea* (L.) R. Br. (*Scirpus setaceus* L.)

About 70 species; widely distributed on all continents but with concentrations of species in eastern and southern Africa and Australia.

Robert Brown (1810) defined the genus *Isolepis* by its lack of hypogynous bristles. This negative definition led to many unrelated species being placed there by nineteenth century botanists and consequently the genus was widely regarded as of no value. *Isolepis* is now generally recognised as a genus although generic limits have been variously set.

Van der Veken (1965) examined the embryos of 28 species in the *Eleogiton-Isolepis-Scirpoides-Ficinia* group and I have examined a further 22 species, including all Australian species of *Isolepis* as well as *Isolepis* spp. (*Scirpus praetextatus* Edgar and *S. sulcatus* Thouars) and *Scirpoides* sp. (*Scirpus dioicus* Boeck.). My results corroborate those of Van der Veken. The embryos of *Ficinia*, *Isolepis* and *Eleogiton* are extremely similar, with the root-cap in a cleft about halfway down the side of the embryo, the germination pore sublateral or nearly median, and the second leaf developed (all these characters as seen in profile (Van der Veken 1965)). Typically *Scirpoides* differs in having a superficial root-cap below the middle of the embryo, the germination pore median, and no second leaf developed. There are, of course, a few species that do not fit these stereotypes. *Scirpus nodosus* (traditionally placed in *Scirpoides*) has an embryo like that of *Isolepis* or *Ficinia*, while *Scirpus luuillinus* and *S. inundatus* (both traditionally placed in *Isolepis*) have embryos which resemble more closely those of *Scirpoides*, and *Scirpus hystrix* (an *Isolepis* sp.) shows a mixture of characters from these two variants of the *Cyperus*-type embryo.

On the basis of morphological characters (such as the presence of a hypogynous disc on the nut in *Ficinia*), *Isolepis* and *Ficinia* (a southern African genus) are generally accepted as genera but the taxa *Scirpoides* (formerly *Holoschoenus* Link) and *Eleogiton* are less certainly placed (Raynal 1977 b) and further study of generic limits is needed in these four taxa, particularly in southern Africa where all four occur.

Scirpoides Séguier seems a particular problem. *S. holoschoenus* (L.) Soják and allied species form a small but relatively well characterised European-African group of slender perennials with capitate, simple or compound inflorescences, readily distinguished from nearly all other species in this group of four taxa. However, the two species found in Australia that have been referred to *Scirpoides*, *Scirpus nodosus* and *S. prolifer*, both vary from typical *Scirpoides*, the former showing affinity with *Ficinia* and the latter with *Isolepis*. Because of the uncertainty of generic position for these two species, I have included them in *Isolepis* pending further investigation. Of the few records of rust or smut fungi attacking *Isolepis* spp., one species of rust fungus may be of interest here. *Uredo scirpi-nodosi* was described on *Scirpus nodosus* and has since been found on *S. prolifer* in Australia (John Walker, pers. comm.) and on *S. inundatus* and *S. sulcatus* in New Zealand (Cunningham 1924, 1927). This may indicate a relationship between the hosts as suggested by Savile (1972, 1979) for other *Scirpus* segregates but it would be premature to come to any conclusion on the basis of these four records of an imperfectly known rust.

There seems reason to regard *Eleogiton* as no more than an aquatic specialisation of *Isolepis*. Van der Veken found that *Eleogiton* embryos were very similar to those of *Isolepis*, differing only in being flattened. He attributed this difference (which he also found amongst *Schoenoplectus* and *Fimbristylis* spp.) to the digyny of *Eleogiton* species as opposed to the trigyny of the *Isolepis* species he examined. Lyc & Haines (1974) found several African species which could be regarded as morphologically intermediate between the long-stemmed, leafy, digynous, aquatic, perennial *Eleogiton* spp. with ebracteate, pedicellate, solitary spikelets and the small, terrestrial, often leafless and perennial, (2-) 3-gynous *Isolepis* spp. with 1-several sessile, pseudolateral spikelets with a leafy involucre bract. As mentioned under *I. fluitans*, even this, the type species of *Eleogiton*, shows considerable variation between aquatic and terrestrial forms, paralleling the seasonal variation observed by Levyns (1944) in the South African species *I. rubicunda* (Nees) Kunth. Because of this morphological variability, *Eleogiton* is not maintained here as a genus distinct from *Isolepis*.

Key to *Isolepis* species in Australia

I. Style 2-fid.

2. Culms weak, floating or creeping, usually long and leafy; lowest involucreal bract glume-like or with a short thickened appendage; spikelet onc.
 3. Spikelets ovate to broad-elliptic in outline, c. 15-flowered, 5–8 mm long; glumes 3.5–4 mm long; stamens 2–3; anthers 1.0–1.5 mm long 6. *I. crassiuscula*
 - 3.* Spikelets \pm elliptic, slender, 5–10 (–12) -flowered, 3–5 mm long.
 4. Glumes c. 3 mm long, usually dark red-brown; stamens 3; anthers 1.5–2.7 mm long; nut narrow-obovate in outline 19. *I. producta*
 - 4.* Glumes 1.8–2.7 mm long, occasionally with red-brown patches; stamens 2 (–3); anthers 0.5–1.0 mm long; nut broad-obovate to broad-elliptic .. 8. *I. fluitans*
- 2.* Culms usually erect, often very short; lowest involucreal bract leaf-like, usually as long as or exceeding the inflorescence; spikelets 1–15.
 5. Dwarf plant with decumbent culms; involucreal bracts several, at least twice as long as culms 11. *I. humillima*
 - 5.* Erect plants to 35 cm tall; involucreal bracts solitary, never more than half as long as culms and usually much shorter.
 6. Glumes 1.5–2.1 mm long; nut 0.8–1.4 mm long.
 7. Spikelets 3–15 in an inflorescence.
 8. Nut longitudinally striate and transversely trabeculate; stamens 1–2 28. *I. wakefieldiana*
 - 8.* Nut smooth; stamens 1 (–2) 13. *I. inundata*
 - 7.* Spikelets 1 (–2).
 9. Glumes red-brown with conspicuous fine, paler nerves; nut pusticulate 23. *I. setiformis*
 - 9.* Glumes green to straw-coloured with inconspicuous nerves; nut smooth 8. *I. fluitans*
 - 6.* Glumes 2.3–3.5 mm long; nut 1.4–1.8 mm long.
 10. Nut pusticulate, greyish; spikelet diameter 2.5–5 mm.
 11. Spikelet 1; involucreal bract usually shorter than inflorescence and caducous; nut orbicular 17. *I. oldfieldiana*
 - 11.* Spikelets (1–) 2–5; involucreal bract as long as or exceeding inflorescence and persistent; nut obovate to elliptic .. 7. *I. cyperoides*
 - 10.* Nut smooth, yellowish; spikelet diameter 1.3–2.5 mm 8. *I. fluitans*

I.* Style 3-fid.

12. Plants with a long-creeping rhizome.
 13. Slender perennial with numerous spikelets clustered in a dense globose head 16. *I. nodosa*
 - 13.* Small annuals with 1–4 spikelets per inflorescence.
 14. Stamens 3 (rarely 1–2 in the upper flowers of a spikelet); spikelet 1 (–2), partially enclosed in the enlarged base of the involucreal bract; involucreal bract caducous 2. *I. aucklandica*
 - 14.* Stamens 1–2 (occasionally 3 in lower flowers); base of involucreal bract not enlarged; bract persistent.
 15. Spikelet 1 (–2); glumes 0.8–1.3 mm long, strongly keeled; nut stipitate but not abruptly so 25. *I. subtilissima*
 - 15.* Spikelets (1–) 2–4; glumes 1.7–2.0 mm long, weakly keeled; nut abruptly stipitate 26. *I. tasmanica*
- 12.* Plants tufted or with a short-ascending rhizome.
 16. Spikelets squarrose; glumes with awns at least as long as the body of the glume 12. *I. hystrix*
 - 16.* Spikelets not squarrose; glumes not long-awned, occasionally short-mucronate.

17. Nut longitudinally striate and transversely trabeculate.
18. Glumes 1.5–2.0 mm long; spikelets 3–15; stamen 1 (–); nut stramineous 28. *I. wakefieldiana*
- 18.* Glumes 1.0–1.5 mm long; spikelets 1–2.
19. Nut \pm globosc, dark grey-brown to \pm black; stamens (2–) 3 10. *I. hookerana*
- 19.* Nut obtusely and unequally trigonous, red-brown; stamens 2 22. *I. setacea*
- 17.* Nut smooth or minutely pusticulate.
20. Stamens 3.
21. Slender perennial with numerous spikelets clustered in a \pm dense head, usually prolific 20. *I. prolifera*
- 21.* Small annuals with 1–4 spikelets per inflorescence, very rarely prolific.
22. Glumes 2.5–3 mm long 1. *I. alpina*
- 22.* Glumes 0.8–2.2 mm long.
23. Nut 0.5–0.6 mm long.
24. Nut dark-brown to black; spikelets 1 (–); glumes 1.0–1.5 mm long 18. *I. platycarpa*
- 24.* Nut straw-coloured; spikelets 1–3; glumes 0.8–1.2 mm long, usually with red-brown patches on the sides 3. *I. australiensis*
- 23.* Nut 0.9–1.5 mm long.
25. Glumes obtuse 4. *I. cernua*
- 25.* Glumes acute.
26. Plant with leaves about twice as long as culms and involucral bracts as long as culms 15. *I. montivaga*
- 26.* Plants with leaves and involucral bracts shorter than culms.
27. Nut unequally trigonous 2. *I. aucklandica*
- 27.* Nut equally trigonous.
28. Plant short-rhizomatous; nut narrow-elliptic, pale yellow; glumes 1–2 mm long, thin-textured, dull, with nerves not conspicuous 9. *I. habra*
- 28.* Plant tufted; nut narrow-obovate, dark golden-brown; glumes 1.5–2.0 mm long, thick-textured, shining, with sides covered in conspicuous nerves 14. *I. marginata*
- 20.* Stamens 1–2.
29. Nut 0.4–0.6 mm long.
30. Glumes 0.5–1.0 mm long, with 3–4 nerves spread over each side 21. *I. sepulcralis*
- 30.* Glumes 0.8–2.0 mm long; sides markedly hyaline, with 0–1 nerves on each side close to keel.
31. Hyaline sides of glumes 0.4–0.6 mm wide, with the cell outlines clearly visible at 15–20 times magnification (cells usually c. 0.1 mm long, 0.05 mm wide); glumes 1.5–2.0 mm long (rarely as short as 1.2 mm); nut broad-elliptic to broad-obovate, with the sides \pm concave, the margins acute, prominent; leaves often 4–9 cm long 5. *I. congrua*
- 31.* Hyaline sides of glumes 0.2–0.3 (–0.4) mm wide, with inconspicuous cells; glumes 0.8–1.6 mm long, nut obovate, with the sides convex or flat, the margins obtuse; leaves usually less than 3 cm long.

32. Glumes usually with dark red-brown patches, 0.8–1.2 mm long, usually without a nerve close to the keel on each side; nut red-brown to dark red-brown 3. *I. australiensis*
- 32.* Glumes usually pallid, rarely with red-brown patches, 1.1–1.6 mm long, with a nerve defining the keel margin on each side; nut grey to black at maturity 27. *I. victoriensis*
- 29.* Nut 0.7–1.5 mm long.
33. Plant with leaves twice as long as culms and involueral bracts as long as culms 15. *I. montivaga*
- 33.* Plants with leaves and involueral bracts shorter than the culms.
34. Glumes with the broad keel produced in a stout mucro; spikelets usually 3-numerous 24. *I. stellata*
- 34.* Glumes mucronulate or with the obvious keel not produced at all.
35. Glumes with dark golden-brown patches; leaf-blades reduced; inflorescence never proliferating 4. *I. cernua*
- 35.* Glumes with dark red-brown patches.
36. Leaf-blades reduced, less than 1 cm long; spikelets 3–15; inflorescence usually proliferating 13. *I. inundata*
- 36.* Leaf-blades 2–12 cm long; spikelets 1–3; inflorescence occasionally proliferating 9. *I. habra*

1. *I. alpina* Hook. f., Fl. Tasmaniae 2: 86, t. 143 (1860).

Scirpus gunnii Boeck., Linnaea 36: 493 (1870); Blake, Proc. Roy. Soc. Queensland 58: 39 (1947).

Description: Willis (1970: 230).

Distribution: Alpine and subalpine regions of Vic. and Tas.

2. *I. aucklandica* Hook. f., Fl. Antarctica 1: 88 (1844), t. 50 (1845).—*Scirpus aucklandicus* (Hook. f.) Boeck., Linnaea 36: 491 (1870); Blake, Contr. Queensland Herb. 8: 18 (1969).

Description: Costin et al. (1970: 138).

Distribution: Tableland regions of southern Qld., N.S.W., Vic. and Tas.; New Guinea, New Zealand and associated subantarctic islands.

3. *I. australiensis* (Maiden & Betche) K. L. Wilson, comb. nov.—*Scirpus cernuus* var. *australiensis* Maiden & Betche, Proc. Linn. Soc. New South Wales 33: 316 (1908), *basionym*.—Holotype: Cobham Lake, N.S.W., W. Bäuerlen, 9.1887 (NSW 73353).—*Scirpus australiensis* (Maiden & Betche) S. T. Blake, Proc. Roy. Soc. Queensland 51: 179 (1940).

Description: Black (1978: 297).

Distribution: Inland regions of N.S.W., Vic., ?S.A., N.T.; *New Zealand.

This species is very closely related to *I. congrua* and *I. victoriensis*. The three species can be distinguished by the characters given in the key; in addition, the culms have more clearly defined ridges in *I. congrua* and *I. victoriensis* than in *I. australiensis*, and the spikelets are generally larger in *I. congrua* than in the other species. The two New Zealand specimens I have seen (CHR 73796 and 92306) agree generally with *I. australiensis*, although the nut is more broadly obovate in the New Zealand specimens.

4. *I. cernua* (Vahl) Roem. & Schult., Syst. Veg. 2: 106 (1817).—*Scirpus cernuus* Vahl, Enum. Pl. 2: 245 (1805); Blake, Contr. Queensland Herb. 8: 18 (1969).

Scirpus psammophilus S. T. Blake, Proc. Roy. Soc. Queensland 51: 178 (1940).

Description: Black (1978: 297).

Distribution: Temperate and subtropical regions, mainly coastal, of all Australian States except the Northern Territory; nearly cosmopolitan.

This widespread and variable species, and allied species such as *I. platycarpa*, *I. setiformis* and *I. verruculosa*, need a world-wide study to determine specific limits. A 2–3-gynous form with blackish, broad-obovate nuts is widespread in Australia (also collected on Norfolk Island) and this may prove to be a distinct species.

5. *I. congrua* Nees in Lehm., Pl. Preiss. 2: 75 (1846).—*Scirpus congrua* (Nees) S. T. Blake, Proc. Roy. Soc. Queensland 48: 90 (1937).

Description: Black (1978: 297).

Distribution: Inland regions of N.S.W., Vic., N.T., S.A. and W.A.

This species is closely related to *I. australiensis* (q.v.) and *I. victoriensis*.

6. *I. crassiuscula* Hook. f., Fl. Tasmaniae 2: 86, t. 143, fig. A (1858).—*Scirpus crassiusculus* (Hook. f.) Benth., Fl. Austral. 7: 326 (1878).—*Eleogiton crassiusculus* (Hook. f.) Soják, Čas. Nár. Mus., Odd. Přír. 148: 193 (1979), as "*crassiusculum*".

Description: Costin et al. (1979: 138).

Distribution: Tableland regions of southern Qld., N.S.W., Vic. and Tas.; Japan, New Guinea, New Zealand.

7. *I. cyperoides* R. Br., Prodr.: 222 (1810).—*Scirpus brunonianus* S. T. Blake, Proc. Roy. Soc. Queensland 51: 179 (1940).

Distribution: SW. W.A.

8. *I. fluitans* (L.) R. Br., Prodr.: 221 (1810).—*Scirpus fluitans* L., Sp. Pl. 1: 48 (1753).—*Eleogiton fluitans* (L.) Link, Hort. Berol. 1: 285 (1827).

Isolepis lenticularis R. Br., Prodr.: 222 (1810).

Description: Black (1978: 298).

Distribution: N.S.W., Vic., Tas., S.A., W.A.; Europe, Africa, Asia, Malesia, New Zealand.

The typical form of *I. fluitans* is aquatic, perennial, with long leafy culms and solitary pedicellate spikelets without a recognisable involucre bract. However this grades into a terrestrial state found on stream and pool margins, which resembles strictly terrestrial *Isolepis* spp. with tufted culms, a leaf-like involucre bract, and sessile spikelets. The very different appearance of this terrestrial state led Robert Brown to describe it as a new species, *I. lenticularis*, but there is no justification for this, since it grades into the typical *I. fluitans* form, sometimes within the one individual plant (Blake 1943; Black 1943).

9. *I. habra* (E. Edgar) Soják, Čas. Nár. Mus., Odd. Přír. 148: 194 (1979).—*Scirpus habrus* E. Edgar, New Zealand J. Bot. 4: 199 (1966).

Description: Costin et al. (1979: 139).

Distribution: Widespread in the tablelands of N.S.W., Vic., Tas.; New Zealand, New Guinea, Philippines.

As with other taxa occurring in both Australia and New Zealand, there appear to be differences between the populations of *I. habra* in the two countries. This species is very closely related to *I. subtilissima*, the distinctions between the two being most clear-cut in New Zealand. These two species need further study.

10. *I. hookerana* Boeck., Flora 41: 418 (1858), as "*hookeriana*".—*Scirpus hookeranus* (Boeck.) S. T. Blake, Contr. Queensland Herb. 8: 19 (1969).

Scirpus calocarpus S. T. Blake, Proc. Roy. Soc. Queensland 51: 179 (1940).

Scirpus setaceus auct. austr. non L.

Description: Black (1978: 299).

Distribution: All Australian States except N.T.

11. *I. humillima* (Benth.) K. L. Wilson, comb. nov.—*Scirpus humillimus* Benth., Fl. Austral. 7: 324 (1878), *basionym*.—Holotype: South Alligator River, Arnhem Land, F. Mueller (K.) Probable isotypes: Tributary of the South Alligator River, Arnhem Land, F. Mueller 5.vii.1856 (MEL, 2 sheets).

[*I. humillima* Hochst. ex C. B. Clarke in Durand & Schinz, Consp. Fl. Africa 5: 616 (1895), nom. nud. in synonym.]

Distribution: Inland areas of northern Qld., N.T. and northern W.A.

This singular species is remarkable for its prostrate habit and capitate inflorescence, in which it is superficially similar to *Cyperus pygmaeus*. It differs from that species in glume and nut shape, in having spirally arranged glumes, and in having non-Kranz leaf anatomy. The embryo of this species resembles that of *Scirpoides* rather than *Isolepis* (see generic notes) but gross morphological features do not suggest a close relationship with *Scirpoides* or indeed any other genus. Pending further study of generic limits, this species is put in *Isolepis*.

12. *I. hystrix* (Thunb.) Nees, Linnaea 7: 496 (1832).—*Scirpus hystrix* Thunb., Prodr. Pl. Capensis: 17 (1794); Raynal, Adansonia 8: 98, pl. 1, fig. 13–15 (1968).

Description: Willis (1970: 228).

Distribution: Scattered occurrences in *N.S.W. and *Vic.; South Africa.

13. *I. inundata* R. Br., Prodr.: 222 (1810).—*Scirpus inundatus* (R. Br.) Poir., Encycl. Suppl. 5: 103 (1817).

I. gunnii Steud., Syn. Pl. Glum. 2: 94 (1855); Blake, Proc. Roy. Soc. Queensland 58: 40 (1947).

Description: Black (1978: 299).

Distribution: All Australian States except N.T.; Malesia, New Zealand, Norfolk Island, Fiji, South America. This is a new record for Fiji, based on *Latz NT 56894*, collected "Nandi area, April 1971" and held in herb. NT.

This species is superficially similar to *I. prolifera*, and its embryo is more similar to those of *Scirpoides* spp. than to those of other *Isolepis* spp. (Van der Veken, 1965). As pointed out under the generic notes, these are two species which require further study to determine the most appropriate generic position. It is undesirable to make new combinations until such studies have been completed.

14. *I. marginata* (Thunb.) A. Dietr., Sp. Pl., edn 6, 1 (2): 110 (1833); Raynal, *Adansonia* 14: 212 (1974).—*Scirpus marginatus* Thunb., Prodr. Pl. Capens.: 17 (1794).

I. cartilaginea R. Br., Prodr.: 222 (1810).

Scirpus antarcticus auct. non. L.: Blake, Contr. Queensland Herb. 8: 16 (1969).

Description: Black (1978: 296).

Distribution: N.S.W., Vic., Tas., S.A., W.A.; South Africa, New Zealand.

15. *I. montivaga* (S. T. Blake) K. L. Wilson, comb. nov.—*Scirpus montivagus* S. T. Blake, Proc. Roy. Soc. Queensland 60: 46 (1949), *basionym*.—Holotype: Mt Buffalo, S. T. Blake 7375, 25.i.1935 (BRI). Isotypes: K, NSW.

Description: Costin et al. (1979: 139).

Distribution: Alpine and subalpine regions of southern N.S.W. and Vic.

16. *I. nodosa* (Rottb.) R. Br., Prodr.: 221 (1810).—*Scirpus nodosus* Rottb., Descr. Icon. Nov. Pl.: 52, t. 8, fig. 3 (1773).—*Holoschoenus nodosus* (Rottb.) A. Dietr., Sp. Pl., edn 6, 2: 165 (1833).—*Scirpoides nodosa* (Rottb.) Soják, Čas. Nár. Mus., Odd. Přír. 141: 62 (1972), as "*nodosus*".

Description: Levyns (1950: 106).

Distribution: All Australian States except the Northern Territory, mainly coastal areas; widespread in temperate regions of the Southern Hemisphere (Skottsberg 1955).

This species may represent a link between *Scirpoides* and *Ficinia*. Superficially it resembles the former genus but it differs in having a small disc (which may or may not fall with the mature nut) at the base of the ovary (Levyns 1944) and also in embryo detail (Van der Veken 1965). It is interesting to note that most Flora writers have not mentioned the disc (gynophore), Bentham (1878) and Levyns (1950) being two exceptions. Owing to the uncertainty of generic placement of this species, I am leaving it in *Isolepis* pending further study of generic limits.

17. *I. oldfieldiana* (S. T. Blake) K. L. Wilson, comb. nov.—*Scirpus oldfieldianus* S. T. Blake, Proc. Roy. Soc. Queensland 51: 179 (1940), *basionym*.—*Scirpus brizoides* Benth., Fl. Austral. 7: 326 (1878), non Willd. ex Link (1820).—Part of the Holotype: Western Australia, 'without definite locality', *Drummond 919* (BRI). Isotypes: MEL, NSW, P.

Distribution: SW. W.A.

18. *I. platycarpa* (S. T. Blake) Soják, Čas. Nár. Mus., Odd. Přír. 148: 194 (1979).—*Scirpus platycarpus* S. T. Blake, Proc. Roy. Soc. Queensland 51: 180 (1940).

Description: Black (1978: 301).

Distribution: N.S.W., Vic., Tas., S.A., SW. W.A.; New Zealand.

19. *I. producta* (C. B. Clarke) K. L. Wilson, comb. nov.—*Scirpus productus* C. B. Clarke, Bull. Misc. Inform. 8: 28 (1908), *basionym*.—Holotype: Tasmania, *Gum 1429* (K). Isotype: NSW.

Description: Black (1978: 301).

Distribution: South Coast of N.S.W., Vic., Tas., S.A., W.A.

This species is closely related to *I. fluitans* (q.v.), differing from the aquatic form of *I. fluitans* in its usually dark red-purple glumes c. 3 mm long (in *fluitans*: green or light red-brown and usually 2–2.5 mm long); 3 stamens with anthers 1.5–

2.7 mm long (*fluitans*: 2(-3) stamens with anthers 0.5-1.1 mm long); narrow-obovate nut with somewhat costate margins (*fluitans*: broad-obovate to suborbicular nut without costate margins); lowest glume bract-like and often as long as spikelet (*fluitans*: lowest glume not bract-like except in terrestrial state). Further study may show that these differences are not sufficiently constant to maintain *I. producta* as a species.

20. *I. prolifera* (Rottb.) R. Br., Prodr.: 223 (1810).—*Scirpus prolifer* Rottb., Descr. Icon. Nov. Pl: 55, t. 17, fig. 2 (1773).

Description: Moore & Edgar (1970: 176).

Distribution: Scattered occurrences in *N.S.W., *Vic., *W.A.; South Africa, *New Zealand.

This species is superficially similar to *Isolepis inundata* (*q.v.*) but is generally coarser in habit. It may be better placed in *Scirpoides* or a genus of its own, but pending further study it is retained in *Isolepis*.

21. *I. sepulcralis* Steud., Syn. Pl. Glum. 2: 94 (1855); Raynal, Adansonia 17: 51 (1977).

Scirpus chlorostachyus Levyns, J. South Afr. Bot. 10: 29 (1944); Raynal, *ibid.*: 51; nom. confus.

Description: Moore & Edgar (1970: 184).

Distribution: *Lower North and Central Coast regions of N.S.W.; eastern and southern Africa, Madagascar, *Tristan da Cunha, *St. Helena, *New Zealand.

22. *I. setacea* (L.) R. Br., Prodr.: 222 (1810).—*Scirpus setaceus* L., Sp. Pl. 1: 49 (1753).

Description: Clapham et al. (1962): 1068.

Distribution: *Tas.; Europe, Africa; introduced to many other regions.

23. *I. setiformis* (S. T. Blake) K. L. Wilson, comb. nov.—*Scirpus setiformis* S. T. Blake, Proc. Roy. Soc. Queensland 51: 178 (1940), *basionym*.—Holotype: Mount Barker, *Oldfield* (BRI). Isotypes: MEL, NSW.

Scirpus arenarius var. ? *setiformis* Benth., Fl. Austral. 7: 326 (1878).

Distribution: SW. W.A.

Blake explicitly describes this as a new species and does not base it on Bentham's variety. This species is closely related to *I. cernua* (*q.v.*) and African species such as *I. verruculosa* (Steud.) Nees.

24. *I. stellata* (C. B. Clarke) K. L. Wilson, comb. nov.—*Scirpus stellatus* C. B. Clarke, Bull. Misc. Inform. 8: 29 (1908), *basionym*.—Holotype: Victoria, *F. Mueller* (K). Isotype: MEL.

Description: Black (1978: 301).

Distribution: Central Coast of N.S.W. (?*), Vic., Tas., S.A., SW. W.A.

25. *I. subtilissima* Boeck., Flora 41: 416 (1858).—*Scirpus subtilissimus* (Boeck.) S. T. Blake, Contr. Queensland Herb. 8: 20 (1969).

Scirpus merrillii (Palla) Kükenth. ex Merrill, Enum. Philipp. Pl. 1: 117 (1923); Blake, Proc. Roy. Soc. Queensland 58: 38 (1947).

Description: Costin et al. (1979: 139).

Distribution: SE. Qld., coastal and tableland regions of N.S.W., Vic., Tas. and S.A.; New Zealand, Malesia.

This species is closely related to *I. habra* (*q.v.*).

26. *I. tasmanica* (S. T. Blake) K. L. Wilson, comb. nov.—*Scirpus tasmanicus* S. T. Blake, Contr. Queensland Herb. 8: 21 (1969), *basionym*.—Holotype: Tasmania, between the Arthur River and Circular Head, F. Mueller (BRI 080376). Isotypes: HO (not seen), K, MEL.

Distribution: Tas.

27. *I. victoriensis* (N. A. Wakef.) K. L. Wilson, comb. nov.—*Scirpus victorieusis* N. A. Wakef., Victorian Naturalist 73: 163 (1957), *basionym*.—Holotype: Wimmera, Victoria, Reader 1891 (MEL). Isotypes: AD (not seen), BRI, K, NSW.

Description: Black (1978: 301).

Distribution: Inland regions of N.S.W. and Vic.

This species is closely related to *I. australiensis* (q.v.) and *I. congrua*.

28. *I. wakefieldiana* (S. T. Blake) K. L. Wilson, comb. nov.—*Scirpus wakefieldianus* S. T. Blake, Proc. Roy. Soc. Queensland 60: 45 (1949), *basionym*.—*Scirpus inuidatus* (R. Br.) Poir. var. *pseudosetaceus* Kükenth., Candollea 6: 427 (1936).—Holotype: Victoria, Healesville, Mt Blackspur, B. P. G. Hochreutiner 3017, 26.ii.1905 (B). Isotype: BRI.

Scirpus costatus (Hochst. ex A. Rich.) Boeck. var. β *gracilis* Boeck., Linnaea 36: 511 (1870), *synon. nov.*—*Lectotype* (here designated): Tasmania, George Town, Gunn 420, 10.i.1843 (K).

Description: Willis (1970: 232).

Distribution: Vic., Tas.

The characters of this species seem to be intermediate between those of *I. inuidata* and *I. hookerana*, and it may be of hybrid origin as suggested by Willis (1970). Its characters are similar to those of the African *I. costata* Hochst. ex A. Rich. but it seems preferable to maintain *I. wakefieldiana* as a separate species until further studies are made of all these species.

OTHER SPECIES SOMETIMES INCLUDED IN *SCIRPUS sens. lat.*

1. *Lipocarpha microcephala* (R. Br.) Kunth, Enum. Pl. 2: 268 (1837).—*Hypaelyptum microcephalum* R. Br., Prodr.: 220 (1810).

Rikliella australiensis J. Raynal, Adansonia 16: 220 (1976), *synon. nov.*

Scirpus squarrosus L. var. *dietrichiae* (Boeck.) Benth., Fl. Austral. 7: 329 (1878).

Description: Kern (1974: 522).

Distribution: All mainland Australian States; Malesia to Japan.

In Australia this species shows such unusual morphological variation in hyaline scale number and size, bract (glume) shape and muero length that Raynal (1976) described a scaleless form as *Rikliella australiensis*. Since then a series of specimens with one or two reduced scales has been collected, connecting this with the typical *L. microcephala* with two hyaline scales enveloping the nut. This variation weakens the force of one of the main generic characters used to distinguish *Lipocarpha*, namely the presence of two hyaline scales at least as long as the nut and enveloping it. However, there is no reason to discard *Lipocarpha* as a genus: it is a generally coherent group of species, with this exceptional form in one species. As Raynal (1973) pointed out, it is not unusual to find these atypical forms and species amongst the more advanced genera of *Cyperaceae*, where the abundance of forms makes generic distinction difficult and gives the impression that "cette explosion évolutive est récente et n'a encore subi que peu d'extinction".

2. *Cyperus hamulosus* M. Bieb., Fl. Taur.-Caucas. 1: 35 (1808).—*Mariscus hamulosus* (M. Bieb.) S. Hooper, Kew Bull. 26: 578 (1972).—*Scirpus hamulosus* (M. Bieb.) Steven, Mém. Soc. Imp. Naturalistes Moscou 5: 356 (1817).

This species from Central Asia and Africa is sporadically naturalised in inland Australia (S.A., N.T., the far NW. of Vic.), probably introduced with camels last century. It is included by Black (1978) under *Scirpus* but its affinities lie with *Cyperus squarrosus* L. (*Mariscus squarrosus* (L.) C. B. Clarke) (Raynal 1967). These two species belong to a highly evolved group within *Mariscus sens. str.* and should perhaps be treated at generic level as a specialised off-shoot of *Mariscus*. However, the delimitation of genera in tribe Cyperaceae is still under review and these two species are left in *Cyperus sens. lat.* pending completion of that study.

ACKNOWLEDGEMENTS

I am grateful for helpful comments on the manuscript received from various colleagues, especially Dr S. Jacobs, Dr L. Johnson and Mr D. McGillivray.

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